

line's suppression of the other eye's view permitted its neighbor to be seen as well; unsystematic observations with various grid spacings suggest that overlapping suppressive fields summate in some fashion, although probably not linearly.

6. M. J. Pickersgill, *Quart. J. Exptl. Psychol.* **11**, 168 (1961); S. Smith, *J. Exptl. Psychol.* **35**, 1 (1945).
7. Thus, in Fig. 1A, if the eyes diverge slightly and the angle between them decreases, the disparity, d , increases for rod 2, but decreases for rod 2'.
8. For example, binocular views illuminated by flashes of light too brief to permit eye movements, and afterimages produced by such flashes (which are of necessity fixed in place on each retina, regardless of the changes in convergence angle between the two eyes, once the flash is over), have been reported to yield correct stereodepth judgments: H. A. Dove, *Ber. Preuss. Akad. Wiss.* **251** (1841), as cited by C. E. Osgood, *Method and Theory in Experimental Psychology* (Oxford Univ. Press, New York, 1953), p. 270; K. N. Ogle and L. Reiher, *Vision Res.* **2**, 439 (1962). Such experiments do not, of course, preclude the occurrence of fragmentary rivalry and alternation between the afterimages of the two eyes' views, and the potential information offered the observer by these phenomena occurring after stimulation should not be dismissed.
9. Supported by NSF grant GB 71.

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Quantasome as a Photosynthetic Unit

Park and Biggins [*Science* **144**, 1009 (1964)] report new structural details of chloroplast lamellar fragments. They explain that they have named these fragments quantasomes because these structures may be the morphological expression of the physiological photosynthetic unit PSU. The idea of PSU-quantasome equivalence is a useful hypothesis [Z. Bay and R. M. Pearlstein, *Proc. Natl. Acad. Sci. U.S.* **50**, 1071 (1963)]. This equivalence is complicated, however, by the existence of two pigment systems in green plant photosynthesis [R. M. Pearlstein, *ibid.*, in press]. It is, therefore, premature to accept this identification of PSU and quantasome as established fact. For this reason, I question your labeling the cover photograph of quantasomes as photosynthetic units.

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Doppler Shifts of Quasars

James Terrell ("Quasi-stellar diameters and intensity fluctuations," 28 Aug., p. 918) has made the interesting suggestion that quasars may be far less distant than is currently believed, hav-

ing been produced by an explosion or explosions within our galaxy. The large red shifts of their spectra must then be interpreted as first-order Doppler shifts caused by extremely high velocities of recession resulting from the explosion.

If an explosion occurred near the center of our galaxy, some of the fragments would move towards the earth; but according to the figures proposed by Terrell they would long since have passed well beyond the earth by a distance of a few galactic diameters. Therefore by now all fragments would be receding from us and all would exhibit Doppler red shifts.

Two possibilities need to be considered in this connection. The first is that a much more recent explosion of the type contemplated by Terrell may have occurred in our galaxy and that some of the fragments from it are still coming toward us. If this were so, these fragments would exhibit large violet shifts, the magnitudes of these shifts depending on the speed and direction of motion of the fragments relative to us. The second possibility is that if explosions of the type described by Terrell have occurred in our galaxy, they may well be assumed to have taken place occasionally in other galaxies too. If so, then some of the fragments could be coming toward us. If they were coming directly toward us they would probably be difficult to detect against the background of the galaxy in which they originated. But if they had also a significant transverse velocity, they could, according to Terrell's figures for a similar event in our own galaxy, move so as to appear a galactic diameter or so away from their parent galaxy and yet still have a component of velocity toward us that would yield a violet shift of the same order of magnitude as that of red shifts actually observed in quasars.

This being so, it might be desirable to search in the neighborhoods of our own and of nearby galaxies for stellar objects having large violet shifts. The lessened brightness due to the greater distance of object associated with nearby galaxies compared with the distances of those associated with our own galaxy would be partly offset by the fact that an object approaching with a speed corresponding to $d\lambda/\lambda = 0.5$ would appear several magnitudes brighter than a similar one receding at the same speed. With the more distant galaxies the main problem would be

lack of brightness rather than the Hubble effect.

That no such "violet-shifted" objects seem yet to have been observed may not prove very much since (i) it is doubtful that anyone has seriously looked for them, and they would probably not be easily noticed unless one were specifically seeking them; and (ii) there is always the possibility (as Terrell has pointed out to me in correspondence) that the explosions are extremely rare events.

If any such violet-shifted objects were detected, their existence would go far toward proving the validity of Terrell's theory. If, however, after considerable search no such objects were found, that fact would tend to weigh against his theory.

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Bone Mineral

In "Radiocarbon dating of bone and shell from their organic components" [*Science* **144**, 999 (1964)] the authors described bone as having the inorganic composition $[\text{Ca}_3(\text{PO}_4)_2]_n \cdot \text{Ca}(\text{OH})_2$. They relegate the carbonate component to the "mortar," along with citrate and other ions.

It has been demonstrated that most, if not all, of the carbonate (a few percent) is incorporated within the crystal structure of the apatite mineral and that the CO_3 groups substitute for PO_4 groups. The nature and extent of carbonate-ion substitution in phosphates, silicates, and sulfates is discussed in the *Journal of Chemical Education* [**40**, 512 (1963)]. Furthermore, it has been shown also that the unit-cell dimension a for the carbonate fluorapatite (francolite) is consistently smaller than for fluorapatite, which proves that the carbonate ions affect this fundamental periodicity of the lattice.

A brief but documented description of the nature of the bone mineral appeared in *Science* **136**, 241 (1962). A more extensive statement, "The crystal structure of bone," can be found in *Clinical Orthopaedics* [**23**, 253 (1962)].

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